GMAT Math: Exponents and Roots

Jeff Sackmann / GMAT HACKS

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Contents

1 Introduction

This document contains nothing but GMAT Exponents and Roots questions–100 of them, to be exact. While most questions in this category rely on a few basic rules, many test-takers don't know those rules, and the harder questions make it difficult to recognize how to apply them.

As in all of my GMAT preparation resources, you'll find these questions indexed by difficulty. That doesn't mean you should skip straight to the hardest questions, or even that you should start with the easier ones. On the GMAT itself, questions won't come labeled with their difficulty level, and despite the intent of the adaptive algorithm, they won't be precisely consistent in terms of difficulty either. Each question presents its own unique challenges, and the sooner you get accustomed to changing gears with every single question, the more time you'll have to prepare for that particular challenge of the exam.

For further practice, I have produced several other resources that may help you. Several of my 100-question practice sets include a fair amount of content that covers Exponents and Roots, including "Number Properties: Challenge," "Data Sufficiency: Challenge," and "Algebra: Challenge." Eventually, you'll start seeing questions that look familiar. That's a good thing: there are only so many ways the GMAT can test these concepts, and if you've done a few hundred Exponents and Roots questions, you've seen just about every permutation they can throw your way.

Also, The GMAT Math Bible has specific chapters (along with focused practice) on both Exponents and Roots.

If you find yourself having problems with only the most difficult questions, you might try my "Extreme Challenge" set, which contains only 720 and higher level questions, many of which are Arithmetic-related.

As far as strategy is concerned, there are dozens of articles at GMAT HACKS to help you with your strategic approach to Arithmetic questions. Most importantly, you should make sure you understand every practice problem you do. It doesn't matter if you get it right the first time–what matters is whether you'll get it right the next time you see it, because the next time you see it could be on the GMAT.

With that in mind, carefully analyze the explanations. Redo questions that took you too long the first time around. Review questions over multiple sessions, rather than cramming for eight hours straight each Saturday. These basic study skills may not feel like the key to GMAT preparation, but they are the difference between those people who reach their score goals and those who never do.

Enough talking; there are 100 Exponents and Roots questions waiting inside. Get to work!

2 Difficulty Levels

In general, the level 4 questions in this guide are 440- to 560-level questions. The level 5 questions in this guide are 560- to 620-level questions. The level 6 questions represent a broad range of difficulty from about 620 to 720, while the level 7 questions are higher still.

Easy (4)
PS
13, 14, 17, 18, 22, 25, 26

Moderate (5)
PS
1, 10, 11, 20, 21, 23, 24, 28, 29, 30, 31, 32, 34, 37, 41, 44, 48, 49, 51
DS
56, 61, 65, 66, 68, 70, 71, 72, 77, 78, 79, 80, 84, 85, 86, 89, 91, 94, 97, 98, 100

Difficult (6)
PS
3, 4, 5, 6, 7, 8, 9, 12, 15, 16, 19, 27, 33, 35, 36, 39, 40, 42, 45, 46, 47, 50, 52, 53, 54
DS
57, 58, 59, 62, 64, 67, 69, 73, 74, 75, 81, 82, 83, 88, 92, 95, 96

Very Difficult (7)
PS
2, 38, 43, 55
DS
60, 63, 76, 87, 90, 93, 99

3 Problem Solving

Note: this guide contains both an answer key (so you can quickly check your answers) and full explanations.

1. If $(x-1)^2 = 625$, which of the following could be the value of $x+1$?
   (A) -21
   (B) -18
   (C) 24
   (D) 27
   (E) 30

2. If $x^2 = 3$, what is the value of $\frac{2^{y^2}}{2^{(x+y)^2}}(4^{xy})$?
   (A) $-\frac{1}{8}$
   (B) $-\frac{1}{2}$
   (C) $\frac{1}{8}$
   (D) $\frac{1}{2}$
   (E) 2

3. What is the units digit of $(7)^4(19)^3(23)^5$?
   (A) 1
   (B) 3
   (C) 5
   (D) 7
   (E) 9

4. If $(2^x)(4^y) = 64$ and $(3^x)(3^y) = 81$, then $(x, y) =$
   (A) $(1, 2)$
   (B) $(2, 1)$
   (C) $(1, 1)$
   (D) $(2, 2)$
   (E) $(1, 3)$

5. $(\frac{1}{4})^{-3}(\frac{1}{8})^{-2}(\frac{1}{32})^{-1} =$
   (A) $(\frac{1}{2})^{-6}$
   (B) $(\frac{1}{2})^{-17}$
   (C) $(\frac{1}{4})^{-9}$
   (D) $(\frac{1}{4})^{-11}$
   (E) $(\frac{1}{8})^{-6}$

6. If k is equal to the sum of $(2x+1)^2$ and $(x-2)^2$, which of the following is equal to the value of $\frac{k}{5}$?

(A) $x(x-1)$
(B) $x(x+1)$
(C) $(x-1)(x+1)$
(D) $(x-1)^2$
(E) x^2+1

7. Which of the following is equal to 100^x for all positive values of x ?

(A) $10^x + 10^x$
(B) 10^{2x}
(C) 10^{10x}
(D) $50^x + 50^x$
(E) $\frac{1000^x}{100^x}$

8. The product of the first five positive odd integers is closest to which of the following powers of 10?

(A) 10^3
(B) 10^4
(C) 10^5
(D) 10^6
(E) 10^7

9. If $10^x - 10^{x-1} = 9(10^{12})$, what is the value of x?

(A) 9
(B) 11
(C) 13
(D) 15
(E) 17

10. $0.1 + 0.1^{-1} + 0.1^{-2} =$

(A) 0.111
(B) 10.01
(C) 11.1
(D) 110.1
(E) 111

11. Which of the following is the value of $\sqrt[3]{(0.008)^2}$?
(A) 0.0004
(B) 0.0008
(C) 0.064
(D) 0.04
(E) 0.08

12. Which of the following is equal to the value of $2^5 + 2^5 + 4^2 + 4^2 + 4^2 + 4^2$?
(A) 2^7
(B) 2^{26}
(C) $2^6 + 4^5$
(D) $2^{10} + 4^8$
(E) $4^5 + 16^2$

13. If y is an integer and 0.0321×10^y is greater than 3,000, what is the least possible value of y?
(A) 2
(B) 3
(C) 4
(D) 5
(E) 6

14. $\sqrt{313}$ is between
(A) 16 and 17
(B) 17 and 18
(C) 18 and 19
(D) 19 and 20
(E) 20 and 21

15. If $\frac{0.018\times10^r}{0.0003\times10^w} = 6 \times 10^7$, then $r - w =$
(A) 6
(B) 7
(C) 8
(D) 9
(E) 15

16. The positive integer p is divisible by 9. If $\sqrt{p}$ is less than 9, which of the following could be the value of $\frac{p}{9}$?
(A) 8
(B) 9
(C) 10
(D) 11
(E) 12

17. $(2^{-3})^{-4}$
   (A) 2^{-12}
   (B) 2^{-7}
   (C) 2^{-1}
   (D) 2^{7}
   (E) 2^{12}

18. $\sqrt{25+25} =$
   (A) $5\sqrt{2}$
   (B) $10\sqrt{2}$
   (C) $25\sqrt{2}$
   (D) 10
   (E) 25

19. Which of these fractions has the greatest value?
   (A) $\frac{1}{3\times 5}$
   (B) $\frac{2}{3^2 5}$
   (C) $\frac{4}{3\times 5^2}$
   (D) $\frac{8}{3^2 5^2}$
   (E) $\frac{135}{3^2 5^3}$

20. Of the following, the closest approximation of $\sqrt{\frac{15.11(59.73)}{35.82}}$ is
   (A) 2
   (B) 5
   (C) $\sqrt{30}$
   (D) $5\sqrt{2}$
   (E) $2\sqrt{15}$

21. If k is a negative integer, what is the greatest possible value of 1.001×10^k?
   (A) 10.01
   (B) 1.001
   (C) 0.1001
   (D) 0.01001
   (E) 0.001001

22. $\frac{3+3\sqrt{5}}{3} =$
   (A) $\sqrt{5}$
   (B) $3\sqrt{5}$
   (C) $1+\sqrt{5}$
   (D) $1+3\sqrt{5}$
   (E) $3+\sqrt{5}$

23. Which of the following must be equal to $(y^5)(y^{10})$?

(A) y^{15}
(B) y^{25}
(C) y^{50}
(D) $3(y^5)$
(E) $5(y^{10})$

24. $\sqrt{(9)(16) + (10)(18)} =$

(A) $6\sqrt{5}$
(B) 15
(C) 18
(D) 24
(E) $12 + 6\sqrt{5}$

25. $\frac{19^3+19}{19} =$

(A) 380
(B) 362
(C) 361
(D) 38
(E) 20

26. $\frac{(0.7)^3}{(0.7)^5}$ is closest to which of the following?

(A) $\frac{1}{7}$
(B) $\frac{1}{2}$
(C) $\frac{3}{4}$
(D) 1
(E) 2

27. If k is a multiple of 3 and $k = (m^2)n$, where m and n are prime numbers, which of the following must be a multiple of 9?

(A) m^2
(B) n^2
(C) mn
(D) mn^2
(E) $(mn)^2$

28. $(\sqrt[3]{6} + \sqrt[3]{6} + \sqrt[3]{6})^3$

(A) $27\sqrt[3]{6}$
(B) $27\sqrt{6}$
(C) 81
(D) 162
(E) $162\sqrt{6}$

29. Which of the following is equal to z^{14} for all positive values of z?

(A) $z^7 + z^7$
(B) $(z^7)^2$
(C) $(z^7)^7$
(D) $(z^4)^{10}$
(E) $(z^2)(z^7)$

30. If $t > 0$ and $\sqrt{\frac{v}{t}} = t$, what is t in terms of v ?

(A) $\frac{1}{v}$
(B) $\sqrt[3]{v}$
(C) $\sqrt{v}$
(D) $v\sqrt{v}$
(E) v^3

31. If y is a negative integer, which of the following expressions has the LEAST value?

(A) y
(B) $y^2 - 0.5$
(C) $y^2 - 1.5$
(D) $y^3 - 1.5$
(E) $y^4 - 0.5$

32. If $m = 0.7$, which of the following is true?

(A) $\sqrt{m} < m < m^2$
(B) $\sqrt{m} < m^2 < m$
(C) $m < \sqrt{m} < m^2$
(D) $m^2 < \sqrt{m} < m$
(E) $m^2 < m < \sqrt{m}$

33. Which of the following is equal to the value of $2^3 + 2^3 + 3^3 + 3^3 + 3^3$?

(A) 5^4
(B) 13^3
(C) $2^4 + 3^4$
(D) $2^5 + 3^6$
(E) $4^3 + 9^3$

34. Which of the following has a value between 0 and 1?
  (A) $\frac{1}{\frac{1}{\sqrt{2}}}$
  (B) $\frac{2}{\sqrt{2}}$
  (C) $\sqrt{\frac{3}{2}}$
  (D) $\frac{\sqrt{3}}{3}$
  (E) $\frac{\sqrt{7}}{2}$

35. If $\frac{r}{s} < 1$, and r and s are positive integers, which of the following must be greater than 1?
  (A) $\frac{\sqrt{r}}{s}$
  (B) $\frac{r}{2s}$
  (C) $\frac{r}{\sqrt{s}}$
  (D) $\frac{s}{r^2}$
  (E) $\frac{2s}{r}$

36. If y and z are integers and $5^{y+4} = 5^{z-2}$, what is z in terms of y?
  (A) $y - 6$
  (B) $y - 2$
  (C) $y + 2$
  (D) $y + 5$
  (E) $y + 6$

37. $(2 - \sqrt{3})(2 + \sqrt{3})(\sqrt{2} + 3)(\sqrt{2} - 3) =$
  (A) -25
  (B) -7
  (C) -1
  (D) 1
  (E) 7

38. If $(2^{13})(9^7) = 3(6^k)$, what is the value of k?
  (A) 7
  (B) 13
  (C) 14
  (D) 15
  (E) 20

39. If $2^x 3^y = 144$, where x and y are positive integers, then $(2^{x-2})(3^{y-1}) =$
    (A) 4
    (B) 6
    (C) 12
    (D) 24
    (E) 36

40. If $5^c - 5^{c-1} = 500$, then $c(c-1) =$
    (A) 72
    (B) 30
    (C) 20
    (D) 12
    (E) 6

41. If $wx \neq 0$, then $w^{-1} - x^{-1} =$
    (A) $x - w$
    (B) $-(w + x)$
    (C) $\frac{x}{w} - \frac{w}{x}$
    (D) $\frac{w-x}{wx}$
    (E) $\frac{x-w}{wx}$

42. $3 + 3 + 3 + 3^2 + 3^2 + 3^3 + 3^3 + 3^4 + 3^4 =$
    (A) 3^5
    (B) 3^6
    (C) 3^8
    (D) 3^{18}
    (E) 3^{21}

43. If $(900)(4,000) = 360(100^x)$, what is the value of x?
    (A) 5
    (B) 4
    (C) 3
    (D) 2
    (E) 1

44. $(1 + \sqrt{7})(1 - \sqrt{7}) =$
    (A) -6
    (B) 6
    (C) 12
    (D) $1 - \sqrt{7}$
    (E) $1 - \sqrt{14}$

45. If $2^{x+5} = 4^{x-3}$, then $x =$

(A) 0
(B) 5
(C) 9
(D) 11
(E) 12

46. If m and v are integers and $m^2 - v^2$ is an odd integer, which of the following must be an even integer?

I. mv
II. $m - v$
III. $2m - v$

(A) None
(B) I only
(C) II only
(D) III only
(E) I, II, and III

47. If $m \neq 0$ and $m - \frac{1+2m^2}{2m} = \frac{y}{m}$, then y is

(A) -1
(B) $-\frac{1}{2}$
(C) $-(1+4m^2)$
(D) $-\frac{1+4m^2}{2}$
(E) $(2m+1)^2$

48. Of the following numbers, which one is third greatest?

(A) $1 - \sqrt{3}$
(B) $\sqrt{3}$
(C) $\sqrt{3} - 1$
(D) $\frac{\sqrt{3}}{2}$
(E) $3\sqrt{3} - 1$

49. If $(11^{\frac{5}{6}})^k = 11$, what is the value of k?

(A) $\frac{1}{6}$
(B) $\frac{1}{5}$
(C) $\frac{1}{3}$
(D) $\frac{3}{5}$
(E) $\frac{6}{5}$

50. If $-1 < n < 0$, which of the following inequalities must be true?

I. $n^4 > n^3$
II. $n^5 > n^3$
III. $n^4 - n^5 > n^2 - n^3$

(A) None
(B) I only
(C) III only
(D) I and II only
(E) I and III only

51. Which of the following is the value of $\sqrt[3]{\sqrt{0.000064}}$?

(A) 0.004
(B) 0.008
(C) 0.02
(D) 0.04
(E) 0.2

52. $\frac{(9^2)(7^3)(2^5)}{84^3} =$

(A) $\frac{1}{3}$
(B) $\frac{2}{3}$
(C) 1
(D) $\frac{3}{2}$
(E) 3

53. If $\sqrt{3-x} = \sqrt{x} + 3$, then $x^2 =$

(A) 1
(B) 3
(C) $2 - 3x$
(D) $3x - 1$
(E) $3x - 9$

54. If k is an integer such that $(-3)^{4k} = 3^{10-k}$, then $k =$

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

55. If $z > 1$, then $\frac{2z^2(z-1)+z-z^2}{z(z-1)} =$

(A) $2z^2 - z$
(B) $2z + 1$
(C) $2z$
(D) $2z - 1$
(E) $z - 2$

4 Data Sufficiency

For all Data Sufficiency questions, the answer choices are as follows:

(A) Statement (1) ALONE is sufficient, but statement (2) alone is not sufficient.
(B) Statement (2) ALONE is sufficient, but statement (1) alone is not sufficient.
(C) BOTH statements TOGETHER are sufficient, but NEITHER statement ALONE is sufficient.
(D) EACH statement ALONE is sufficient.
(E) Statements (1) and (2) TOGETHER are NOT sufficient.

56. What is the value of $y^3 - t^3$?

(1) $y - t = 3$
(2) $y^2 - t^2 = 21$

57. If x is an integer greater than 1, is x equal to 2^k for some positive integer k?

(1) x has only one prime factor.
(2) Every factor of x is even.

58. If x is positive, is $x > 4$?

(1) $(4 - x)^2 < 1$
(2) $(x - 4)^2 < 1$

59. Is $a^2 + b^2 > c^2$?

(1) $a^3 + b^3 > c^3$
(2) $a + b > c$

60. If p is a positive integer and r is the remainder when $p^2 - 1$ is divided by 8, what is the value of r ?

(1) When p is divided by 4, the remainder is zero.
(2) When p is divided by 8, the remainder is not zero.

61. What is the value of xz?

(1) $x^z = \frac{1}{2}$
(2) x is a positive integer and z is a negative integer.

62. Is $x > 0$?

(1) $x < x^2$
(2) $x^2 < x^3$

63. Is $8^n < 1,000$?
    (1) $8^{n-1} > 50$
    (2) $8^n = 8^{n-1} + 448$

64. If $x \neq 0$, what is the value of $\left(\frac{x^m}{x^n}\right)^4$?
    (1) $x^m = 16(x^n)$
    (2) $x^n = 16$

65.. If $-25 < j < 25$, is $j > 0$?
    (1) $j^2 = j$
    (2) $j^3 = j$

66. Is n^2 an even integer?
    (1) n is an even integer.
    (2) $\sqrt{n}$ is an even integer.

67. Is x^2 greater than x ?
    (1) x^2 is greater than x^3.
    (2) x^2 is greater than x^4.

68. If $yz = 6$, what is the value of $yz(y - z)$?
    (1) $yz^2 = -12$
    (2) $y + z = -5$

69. Is x greater than x^2 ?
    (1) x is greater than x^3.
    (2) x is greater than x^4.

70. Is $x > 2$?
    (1) $(x - 1)^2 > 1$
    (2) $\sqrt{x - 1} > 1$

71. Is x between 0 and 1?
    (1) $x < x^2$
    (2) $x < x^3$

72. If x is an integer, is $\frac{30-x}{x}$ an integer?
    (1) $x^2 + x = 30$
    (2) $2x^2 - 4x = 30$

73. Is $\frac{3^{x+2}}{9} > 1$?
    (1) $9^x > 1$
    (2) $x > 0$

74. If k and m are positive integers, is $(\sqrt{k})^m$ an integer?
   (1) $\sqrt{k}$ is an even integer.
   (2) $\sqrt{m}$ is an even integer.

75. What is the units digit of integer s?
   (1) The units digit of s^2 is double the units digit of s.
   (2) The units digit of s^3 is four times the units digit of s.

76. If a and b are positive integers, what is the remainder when $9^{(2a+1+b)}$ is divided by 10?
   (1) $a = 3$
   (2) b is odd.

77. If $ab = c$, what is the value of bc?
   (1) $a = \frac{18}{b^2}$
   (2) $b = 3$

78. If r, s, and t are integers, is $t > 0$?
   (1) $t = r^2 - 1$
   (2) $t = s^4 - 1$

79. If $S = y^2 + 2xy + x^2$, what is the value of xy?
   (1) $x + y = 1$
   (2) $S = 1$

80. If $n^k = 1$, what is the value of k?
   (1) n is positive.
   (2) $n^k = (n + 1)^k$

81. If x is an integer, is $(x^2 - 1)(x - 3)$ an even number?
   (1) x is even.
   (2) Each prime factor of $(x^2 + 1)$ is greater than 3.

82. If P is a positive integer, is the units digit of P equal to zero?
   (1) 14 and 15 are factors of P.
   (2) $P = (2^4)(3^3)(5^2)(7^4)$

83. If a and b are positive integers, what is the value of $a + b$?
   (1) $(2^a)(3^b) = 144$
   (2) $(2^a)(2^b) = 64$

84. What is the value of j?
(1) $j^2 = 16$
(2) $j^2 + 16 = 8j$

85. If $\frac{\sqrt{x}}{w} = z$, what is the value of x?
(1) $wz = 18$
(2) $w = 4$ and $z = \frac{9}{2}$

86. Is $x > 4$?
(1) $(x + 1)^2 > 4$
(2) $(x - 1)^2 > 4$

87. If k is a positive integer, is the value of $x - y$ less than half the value of $3^k - 2^k$?
(1) $x = 3^{k-1}$ and $y = 2^{k-1}$
(2) $k = 2$

88. If x and z are positive integers, is $\sqrt{2x + z}$ an integer?
(1) $z = 2x + 1$
(2) $z = x^2 + 1$

89. What is the value of $x^4 - y^4$?
(1) $x^2 + y^2 = 29$
(2) $x + y = 7$

90. If z is an integer, is $4^z + \frac{1}{4^z} = p$?
(1) $2^z + \frac{1}{2^z} = \sqrt{p + 2}$
(2) z is positive.

91. Is b an integer?
(1) b^3 is an integer.
(2) $\sqrt[3]{b}$ is an integer.

92. If k is a positive integer, is $k^3 - k$ divisible by 4?
(1) $k + 2$ is divisible by 4
(2) $k - 2$ is divisible by 4.

93. If y is a positive integer, is $\sqrt{y}$ an integer?
(1) $\sqrt{4y}$ is not an integer.
(2) $\sqrt{5y}$ is an integer.

94. If x is a positive integer, is $\sqrt{\sqrt{x}}$ an integer?
   (1) x is the square of an integer.
   (2) $\sqrt{x}$ is the square of an integer.

95. If m and n are positive integers, is $m^n < n^m$?
   (1) $m = \sqrt{n}$
   (2) $n > 5$

96. If p is a postive integer less than 29 and q is the remainder when 29 is divided by p, what is the value of q?
   (1) p is a two-digit number.
   (2) $p = 3^k$, where k is a positive integer.

97. If s is positive, is rs positive?
   (1) $r^2s > 0$
   (2) $rs^2 > 0$

98. Is x^2 greater than $x - y$?
   (1) $y - x$ is positive.
   (2) $x > 1$ and $y > 1$.

99. What is the remainder when the positive integer x is divided by the positive integer m, where $m > 4$?
   (1) $x = (m + 2)^2$
   (2) $m = 7$

100. Is x between 0 and 1?
   (1) x^5 is positive.
   (2) x^4 is less than x.

5 Answer Key

For full explanations, see the next section.

1. D
2. C
3. D
4. D
5. B
6. E
7. B
8. A
9. C
10. D
11. D
12. A
13. D
14. B
15. A
16. A
17. E
18. A
19. E
20. B
21. C
22. C
23. A
24. C
25. B
26. E
27. E
28. D
29. B
30. B
31. D
32. E
33. C
34. D
35. E
36. E
37. B
38. B
39. C
40. D
41. E

42.	A
43.	D
44.	A
45.	D
46.	B
47.	B
48.	D
49.	E
50.	D
51.	E
52.	D
53.	E
54.	B
55.	D
56.	C
57.	B
58.	E
59.	E
60.	A
61.	C
62.	B
63.	B
64.	A
65.	E
66.	D
67.	E
68.	A
69.	B
70.	B
71.	D
72.	D
73.	D
74.	D
75.	D
76.	B
77.	A
78.	E
79.	E
80.	B
81.	D
82.	D
83.	D
84.	B
85.	D
86.	E
87.	A

88. B
89. E
90. A
91. B
92. D
93. D
94. B
95. C
96. C
97. B
98. D
99. A
100. C

6 Explanations

For a quick-reference answer key, see the previous section.

1. D

Explanation: 625 is 25^2, which means it could also be $(-25)^2$. That gives us two possible values for x, which we'll have to find separately:
$x - 1 = 25$
$x = 26$
$x + 1 = 27$
That's one of the choices, so (D) must be correct.
The other solution is as follows:
$x - 1 = -25$
$x = -24$
$x + 1 = -23$

2. C

Explanation: First, simplify the fraction:
$2^{y^2-(x+y)^2}(4^{xy})$
Multiply out the binomial, and change the second term so that the base is 2:
$2^{y^2-(x^2+2xy+y^2)}(2^2)^{xy}$
$2^{y^2-x^2-2xy-y^2}2^{2xy}$
Combine the exponents:
2^{-x^2}
$x^2 = 3$, so $2^{-x^2} = 2^{-3} = \frac{1}{2^3} = \frac{1}{8}$, choice (C).

3. D

Explanation: To find the units digit of such a large number, focus on the units digits of the component terms:
$7^4 = 49^2$, which has the same units digit as 9^2: 1.
19^3 has the same units digit as 9^3: 9.
23^5 has the same units digit as 3^5, which is the product of the units digits of 3^2 and 3^3: $(9)(7) = 63$, for a units digit of 3.
Finally, combine the components. The units digits are 1, 9, and 3, so the units digit of the result is the units digit of $(1)(9)(3) = 27$, choice (D).

4. D

Explanation: To work with all of these exponents, make all of the bases in each equation equal. First, with $(2^x)(4^y) = 64$:
$(2^x)((2^2)^y) = 2^6$
$(2^x)(2^{2y}) = 2^6$
$2^{x+2y} = 2^6$
$x + 2y = 6$

That's a lot of steps, but when you're comfortable with all of the exponent rules (which you should become, if you're not already), they'll come quickly, and you may be able to skip a few along the way. Now do the same with $(3^x)(3^y) = 81$:

$3^{x+y} = 3^4$

$x + y = 4$

Now you have two linear equations with two variables. Subtract the second from the first, and the result is $y = 2$, which means that x must equal 2. Thus, $(x, y) = (2, 2)$, choice (D).

5. B

Explanation: Because all of the denominators are powers of 2, you can make them more similar by converting to equivalent powers of 2:

$(\frac{1}{4})^{-3} = (\frac{1}{2^2})^{-3} = (\frac{1}{2})^{-6}$

$(\frac{1}{8})^{-2} = (\frac{1}{2^3})^{-2} = (\frac{1}{2})^{-6}$

$(\frac{1}{32})^{-1} = (\frac{1}{2^5})^{-1} = (\frac{1}{2})^{-5}$

To combine the results:

$(\frac{1}{2})^{-6}(\frac{1}{2})^{-6}(\frac{1}{2})^{-5} = (\frac{1}{2})^{-17}$, choice (B).

6. E

Explanation: When the answer is something like $\frac{k}{5}$, odds are the value of k is going to be easily divisible by 5. If you do the math and it doesn't work out that way, you might not be wrong, but it's worth checking.

To begin, simplify the two expressions:

$(2x + 1)^2 = (2x + 1)(2x + 1) = 4x^2 + 4x + 1$

$(x - 2)^2 = (x - 2)(x - 2) = x^2 - 4x + 4$

Add them, and the result is $5x^2 + 5$. As we predicted, it's easily divisible by 5.

$\frac{5x^2+5}{5} = x^2 + 1$, choice (E).

7. B

Explanation: $100 = 10^2$, so $100^x = (10^2)^x = 10^{2x}$, choice (B).

8. A

Explanation: We're looking for the product of 1(3)(5)(7)(9). Since the answer choices are so far apart, we can aggressively approximate. $3(7) \approx 20$, so $3(7)(5) \approx 100$. Then, since $9(1) \approx 10$, the product of the five integers is approximately $10(100) = 1000 = 10^3$.

9. C

Explanation: Simplify the left side of the equation:

$10^x - 10^{x-1} = 10^x - 10^x 10^{-1} = 10^x(1 - \frac{1}{10}) = 10^x(\frac{9}{10})$

Divide both sides by 9:

$10^x(\frac{1}{10}) = 10^{12}$

$10^x 10^{-1} = 10^{12}$

$10^{x-1} = 10^{12}$

$x - 1 = 12$
$x = 13$, choice (C).

10. D
Explanation: This is easiest to handle if you convert everything to fractions:
$\frac{1}{10} + (\frac{1}{10})^{-1} + (\frac{1}{10})^{-2} =$
$\frac{1}{10} + 10^1 + 10^2 =$
$\frac{1}{10} + 10 + 100 = 110\frac{1}{10} = 110.1$, choice (D).

11. D
Explanation: It takes a little more work, but I prefer using scientific notation on problems like this to avoid the careless mistakes that stem from keeping track of all those zeroes:
$\sqrt[3]{(8 \times 10^{-3})^2} =$
$\sqrt[3]{64 \times 10^{-6}} =$
$\sqrt[3]{64} \times \sqrt[3]{10^{-6}} =$
$4 \times (10^{-6})^{\frac{1}{3}} = 4 \times 10^{-2} = 0.04$, choice (D).

12. A
Explanation: To combine terms with exponents, the first step is to make the bases equal. $4^2 = (2^2)^2 = 2^4$, so we can rewrite the question as:
$2^5 + 2^5 + 2^4 + 2^4 + 2^4 + 2^4$
Factor out 2^4:
$2^4(2 + 2 + 1 + 1 + 1 + 1) = 2^4(8) = 2^4(2^3) = 2^7$, choice (A).

13. D
Explanation: The value of y only moves the decimal point, so we can predict what the smallest value of y will be the one that makes 0.0321×10^y greater than 3,000. It's the one that makes $0.0321 \times 10^y = 3,210$. That requires moving the decimal point five digits to the right, which is the same as multiplying by 10^5. Thus, $y = 5$ for that value of 0.0321×10^y. Choice (D) is correct.

14. B
Explanation: You probably don't have to do any calculation to determine that the answer is closer to (A) than (E): 20 is equal to $\sqrt{400}$, so $\sqrt{313}$ must be quite a bit smaller.
It will take a bit of arithmetic, though: $17^2 = 289$, which suggests that $\sqrt{313}$ is between 17 and 18. $18^2 = 324$, which confirms the suggestion. (B) is correct.

15. A
Explanation: Simplify the left side of the equation so that you can divide 18 by 3 to get 6 on the left side as well as on the right:
$\frac{0.018 \times 10^r}{0.0003 \times 10^w} =$
$\frac{18 \times 10^{-3} \times 10^r}{3 \times 10^{-4} \times 10^w} =$

$6 \times \frac{10^{r-3}}{10^{w-4}} =$
$6 \times 10^{(r-3)-(w-4)} =$
$6 \times 10^{r-w+1}$
Finally, set it equal to the right side:
$6 \times 10^{r-w+1} = 6 \times 10^7$
$10^{r-w+1} = 10^7$
$r - w + 1 = 7$
$r - w = 6$, choice (A).

16. A
Explanation: If $\sqrt{p}$ is less than 9, p must be less than $9^2 = 81$. Thus, $\frac{p}{9}$ must be less than $\frac{81}{9} = 9$. If the answer must be less than 9, the only possible choice is (A), 8.

17. E
Explanation: The value of a negative exponent is the reciprocal of the value of the corresponding positive exponent. However, if you start messing around with fractions, you're making the problem harder than it needs to be.

When a number raised to a power is raised to another power, the result is the original number raised to the product of the two powers. In this case, $(2^{-3})^{-4} = 2^{(-3)(-4)} = 2^{12}$, choice (E).

18. A
Explanation: Rather than adding the terms on the inside of the square root (that's what the GMAT expects you to do, and wants to see if you can avoid), keep a 25 under the square root:
$\sqrt{25 + 25} = \sqrt{2(25)}$
That's equal to $\sqrt{2}\sqrt{25}$, or $5\sqrt{2}$, choice (A).

19. E
Explanation: To compare the fractions, find a common denominator. Since all the denominators are in terms of 3's and 5's, you can use the largest of them, $3^2 5^3$ as the common base. Convert each of the other four answers and compare to (E):
(A) $\frac{1}{3 \times 5} \times \frac{3(5)(5)}{3(5)(5)} = \frac{75}{3^2 5^3}$
(B) $\frac{2}{3^2 5} \times \frac{5(5)}{5(5)} = \frac{50}{3^2 5^3}$
(C) $\frac{4}{3 \times 5^2} \times \frac{3(5)}{3(5)} = \frac{60}{3^2 5^3}$
(D) $\frac{8}{3^2 5^2} \times \frac{5}{5} = \frac{40}{3^2 5^3}$
(E) $\frac{135}{3^2 5^3}$
(E) is the largest, so it is the correct answer.

20. B
Explanation: When the question tells you to approximate, don't hesitate to do so:

$\sqrt{\frac{15.11(59.73)}{35.82}} \approx \sqrt{\frac{(15)(60)}{36}} = \frac{\sqrt{(15)(15)(4)}}{\sqrt{36}} = \frac{\sqrt{(15)(15)}\sqrt{4}}{6} = \frac{15(2)}{6} = 5$, choice (B).

21. C
Explanation: The smaller the value of k, the smaller the value of 1.001×10^k, so in order to maximize the value of 1.001×10^k, we must maximize the value of k. The largest negative integer is –1, so k must be –1. $1.001 \times 10^{-1} = 0.1001$, choice (C).

22. C
Explanation: Factor out of a 3 in the numerator:
$\frac{3(1+\sqrt{5})}{3} = 1 + \sqrt{5}$, choice (C).

23. A
Explanation: Apply an exponent rule I hope is familiar:
$(y^5)(y^{10}) = y^{15}$, choice (A).

24. C
Explanation: Rather than multiplying and then adding the terms inside the square root sign, and having to deal with the square root of a large number, look for terms that can be factored:
$\sqrt{(9)(16) + (10)(18)} =$
$\sqrt{9(16) + (10)(2)} =$
$\sqrt{9}\sqrt{16 + 20} =$
$3\sqrt{4(4 + 5)} =$
$3\sqrt{4(9)} =$
$3\sqrt{4}\sqrt{9} = 3(2)(3) = 18$, choice (C).

25. B
Explanation: Factor out 19 in the numerator:
$\frac{19(19^2+1)}{19} = 19^2 + 1 = 361 + 1 = 362$, choice (B).

26. E
Explanation: Use the rule for exponents in a fraction with the same base:
$(0.7)^{3-5} = 0.7^{-2} = (\frac{7}{10})^{-2}$
That's equal to the reciprocal of the positive exponent:
$(\frac{10}{7})^2 = \frac{100}{49} \approx 2$, choice (E).

27. E
Explanation: If $(m^2)n$ is a multiple of 3 and the two variables are both prime numbers, either m or n (or both) must be 3. Go through each of the choices, see if it must be a multiple of 9:
(A) not a multiple of 9 if m is not 3
(B) not a multiple of 9 if n is not 3

(C) not a multiple of 9, since m or n is 3, and the other is a different prime number
(D) not a multiple of 9 if $m = 3$ and n is another prime number
(E) this is our answer. Either m or n must be 3, so mn is a multiple of 3, so $(mn)^2$ is a multiple of 9. (E) is the correct choice.

28. D
Explanation: $\sqrt[3]{6} + \sqrt[3]{6} + \sqrt[3]{6} = 3\sqrt[3]{6}$
$(3\sqrt[3]{6})^3 = (3)^3(\sqrt[3]{6})^3 = (27)(6) = 162$, choice (D).

29. B
Explanation: Go through each of the choices:
(A) $z^7 + z^7 = 2(z^7)$
(B) $(z^7)^2 = z^{7(2)} = z^{14}$
(C) $(z^7)^7 = z^{7(7)} = z^{49}$
(D) $(z^4)^{10} = z^{4(10)} = z^{40}$
(E) $(z^2)(z^7) = z^{2+7} = z^9$
Choice (B) is correct.

30. B
Explanation: First, square both sides:
$(\sqrt{\frac{v}{t}})^2 = t^2$
$\frac{v}{t} = t^2$
$v = t^3$
$\sqrt[3]{t^3} = \sqrt[3]{v}$
$t = \sqrt[3]{v}$, choice (B).

31. D
Explanation: Try a number for y that's easy to work with, such as $y = -2$:
(A) -2
(B) $-2^2 - 0.5 = 4 - 0.5 = 3.5$
(C) $-2^2 - 1.5 = 4 - 1.5 = 2.5$
(D) $-2^3 - 1.5 = -8 - 1.5 = -9.5$
(E) $-2^4 - 0.5 = 16 - 0.5 = 15.5$
(D) is the least value, so (D) is correct.

32. E
Explanation: For all numbers between 0 and 1, the square root of the number is closer to one, so it is greater than the number itself. The square, on the other hand, is closer to zero–smaller than the number itself. In terms of m:
$m^2 < m < \sqrt{m}$, choice (E).

33. C
Explanation: Group like terms:
$2^3 + 2^3 + 3^3 + 3^3 + 3^3 =$

$2(2^3) + 3(3^3) =$
$2^1(2^3) + 3^1(3^3) =$
$2^4 + 3^4$, choice (C).

34. D
Explanation: Approximate the value of each choice:
(A) $\frac{1}{\frac{1}{\sqrt{2}}} = \sqrt{2} \approx 1.4$
(B) $\frac{2}{\sqrt{2}} \approx \frac{2}{1.4}$, greater than 1.
(C) $\sqrt{\frac{3}{2}} = \frac{\sqrt{3}}{\sqrt{2}} \approx \frac{1.7}{1.4}$, greater than 1.
(D) $\frac{\sqrt{3}}{3} \approx \frac{1.7}{3}$, a little more than 0.5, so between 0 and 1.
(E) $\frac{\sqrt{7}}{2} \approx \frac{2.5}{2}$, greater than 1.
(D) is correct.

35. E
Explanation: Since we know that s is a positive integer, we can simplify the given inequality by multiplying both sides by s:
$r < s$
Going through each of the choices:
(A) If r is less than s, $\sqrt{r}$ must also be less than s, so $\frac{\sqrt{r}}{s}$ is less than 1.
(B) $2s$ is larger than s, so r must be less than $2s$, so $\frac{r}{2s}$ is less than 1.
(C) We don't know whether $\sqrt{s}$ is greater or less than r, but it could be; this could be greater or less than 1.
(D) Similar to (C), we don't know how r^2 compares to s, so this could be greater or less than 1.
(E) This is the reciprocal of (B). Since (B) is less than 1, (E) must be greater than 1.
(E) is the correct choice.

36. E
Explanation: Since we know that s is a positive integer, we can simplify the given inequality by multiplying both sides by s:
$r < s$
Going through each of the choices:
(A) If r is less than s, $\sqrt{r}$ must also be less than s, so $\frac{\sqrt{r}}{s}$ is less than 1.
(B) $2s$ is larger than s, so r must be less than $2s$, so $\frac{r}{2s}$ is less than 1.
(C) We don't know whether $\sqrt{s}$ is greater or less than r, but it could be; this could be greater or less than 1.
(D) Similar to (C), we don't know how r^2 compares to s, so this could be greater or less than 1.
(E) This is the reciprocal of (B). Since (B) is less than 1, (E) must be greater than 1.
(E) is the correct choice.

37. B

Explanation: The first two terms and the last two terms each constitute the difference of squares:
$(2-\sqrt{3})(2+\sqrt{3}) = 2^2 - (\sqrt{3})^2 = 4 - 3 = 1$
$(\sqrt{2}+3)(\sqrt{2}-3) = (\sqrt{2})^2 - 3^2 = 2 - 9 = -7$
The product, then, is $(1)(-7) = -7$, choice (B).

38. B
Explanation: Reduce each term to its prime factors raised to exponents:
$(2^{13})(9^7) = (2^{13})(3^2)^7 = (2^{13})(3^{14})$
$3(6^k) = 3(2^k)(3^k)$
So, the resulting equation is:
$(2^{13})(3^{14}) = 3(2^k)(3^k)$
$(2^{13})(3^{13}) = (2^k)(3^k)$
$k = 13$, choice (B).

39. C
Explanation: It's possible to solve for x and y given the equation $2^x 3^y = 144$ by finding the prime factorization of 144, but there's a better way.
$(2^{x-2})(3^{y-1}) =$
$(2^x)(2^{-2})(3^y)(3^{-1}) =$
$(2^x)(3^y)(\frac{1}{4})(\frac{1}{3})$
Since we know that $2^x 3^y = 144$, we can substitute:
$(2^x)(3^y)(\frac{1}{4})(\frac{1}{3}) = 144(\frac{1}{12}) = 12$, choice (C).

40. D
Explanation: $5^c - 5^{c-1} =$
$5^c - 5^c 5^{-1} =$
$5^c(1 - \frac{1}{5}) =$
$5^c(\frac{4}{5}) = 500$
$5^c = 500(\frac{5}{4}) = \frac{2500}{4} = 625$
If $5^c = 625$, $c = 4$, so:
$c(c-1) = 4(3) = 12$, choice (D).

41. E
Explanation: Convert the two negative exponents to their reciprocals:
$\frac{1}{w} - \frac{1}{x} =$
$\frac{x}{wx} - \frac{w}{wx} =$
$\frac{x-w}{wx}$, choice (E).

42. A
Explanation: There's a 3 in every term, so start by factoring that out:
$3(1+1+1+3+3+3^2+3^2+3^3+3^3) =$
$3(3+3+3+3^2+3^2+3^3+3^3)$
Factor out a 3 from the remaining terms inside the parentheses:
$3(3)(1+1+1+3+3+3^2+3^2) =$
$3(3)(3+3+3+3^2+3^2) =$

Again:
$3(3)(3)(1+1+1+3+3) =$
$3(3)(3)(3+3+3) =$
$3(3)(3)(9) =$
$3(3)(3)(3)(3) = 3^5$, choice (A).

43. D
Explanation: First, try to isolate 100^x on one side by eliminating the 360:
$(900)(4,000) = 360(100^x)$
$\frac{(900)(4,000)}{360} = (100^x)$
$\frac{(9)(100)(40)(100)}{9(40)} =$
$(100)(100) = 100^x$
$100^2 = 100^x$
$x = 2$, choice (D).

44. A
Explanation: This is the difference of squares, equivalent to:
$1^2 - (\sqrt{7})^2 =$
$1 - 7 = -6$, choice (A).

45. D
Explanation: Start by making both bases the same:
$2^{x+5} = 4^{x-3}$
$2^{x+5} = (2^2)^{x-3}$
$2^{x+5} = 2^{2x-6}$
With the bases the same, you can set the exponents equal to each other:
$x + 5 = 2x - 6$
$x = 11$, choice (D).

46. B
Explanation: If $m^2 - v^2$ is odd, one of the two variables must be even while the other is odd. If m^2 is odd, then m is odd–and the same goes if it is even, and the same applies to v. In short: one is even, one is odd.

I must be even: even times odd, or odd times even, each results in an even. (B) or (E) is correct.

II must be odd: even minus odd, or odd minus even, each results in an odd. (B) must be correct.

III. might be even or odd. If $m = even$, $2(even) - odd = odd$. but if $m = odd$, $2(odd) - even = even$. (B) is correct.

47. B
Explanation: Start simplifying by multiplying each side by m:
$m(m - \frac{1+2m^2}{2m}) = m(\frac{y}{m})$
$m^2 - m(\frac{1+2m^2}{2m}) = y$

$y = m^2 - (\frac{1+2m^2}{2}) =$
$m^2 - \frac{1}{2} - \frac{2m^2}{2} =$
$m^2 - \frac{1}{2} - m^2 =$
$-\frac{1}{2}$, choice (B).

48. D
Explanation: Approximate the value of each choice:
(A) $1 - \sqrt{3} \approx 1 - 1.7 = -0.7$
(B) $\sqrt{3} \approx 1.7$
(C) $\sqrt{3} - 1 \approx 1.7 - 1 = 0.7$
(D) $\frac{\sqrt{3}}{2} \approx \frac{1.7}{2} = 0.85$
(E) $3\sqrt{3} - 1 \approx 3(1.7) - 1 = 5.1 - 1 = 4.1$
The third largest is 0.85, choice (D).

49. E
Explanation: $(11^{\frac{5}{6}})^k = 11^{\frac{5}{6}k}$, and $11 = 11^1$, so $\frac{5}{6}k = 1$.
Thus, $k = \frac{6}{5}$, chocie (E).

50. D
Explanation: Since you know that n is negative, you can simplify each of the inequalities:
I. $n^4 > n^3$
$\frac{n^4}{n^3} > \frac{n^3}{n^3}$
$n < 1$
If n is between -1 and 0, n must be less than 1, so I is true.
II. $n^5 > n^3$
$\frac{n^5}{n^3} > \frac{n^3}{n^3}$
$n^2 < 1$
Again, since n is between -1 and 0, n^2 must be less than 1, so II is true.
III. $n^4 - n^5 > n^2 - n^3$
$\frac{n^4 - n^5}{n^2} > \frac{n^2 - n^3}{n^2}$
$n^2 - n^3 > 1 - n$
Because n is between -1 and 0, n^2 and n^3 are closer to 0 than 1 and n are, so the difference between them is smaller than the difference between 1 and n. III is not true, so the correct choice is (D), I and II.

51. E
Explanation: It may take a bit longer, but I prefer doing problems like this using scientific notation to ensure that I don't make a careless mistake keeping track of all the zeroes.
$\sqrt[3]{\sqrt{0.000064}} =$
$\sqrt[3]{\sqrt{64 \times 10^{-6}}} =$
$\sqrt[3]{\sqrt{64} \times \sqrt{10^{-6}}} =$
$\sqrt[3]{8 \times 10^{-3}} =$
$\sqrt[3]{8} \times \sqrt[3]{10^{-3}} =$

$2 \times 10^{-1} = 0.2$, choice (E).

52. D
Explanation: Reduce each term to its prime factors for easier simplification:
$\frac{(9^2)(7^3)(2^5)}{84^3} =$
$\frac{((3^3)^2)(7^3)(2^5)}{7^3 4^3 3^3} =$
$\frac{(3^4)(7^3)(2^5)}{7^3 2^6 3^3} = \frac{3}{2}$, choice (D).

53. E
Explanation: First, square each side to get rid of the radical signs:
$\left(\sqrt{3-x}\right)^2 = \left(\sqrt{x}+3\right)^2$
$3 - x = x + 2(3\sqrt{x}) + 9$
$0 = 2x + 6\sqrt{x} + 6$
$0 = x + 3\sqrt{x} + 3$
$-3\sqrt{x} = x + 3$
$(-3\sqrt{x})^2 = (x+3)^2$
$9x = x^2 + 6x + 9$
$x^2 = 3x - 9$, choice (E).

54. B
Explanation: You can ignore the negative sign on the three on the left side of the equation. Since k is an integer, $4k$ must be even, and any number raised to an even exponent ends up positive. Thus, the question is equivalent to:
$(3)^{4k} = 3^{10-k}$
Since the bases are equal, the exponents must be, as well:
$4k = 10 - k$
$5k = 10$
$k = 2$, choice (B).

55. D
Explanation: Factor out a $(z-1)$ from the last two terms of the numerator:
$\frac{2z^2(z-1)+z-z^2}{z(z-1)} =$
$\frac{2z^2(z-1)-z^2+z}{z(z-1)} =$
$\frac{2z^2(z-1)-z(z-1)}{z(z-1)} =$
$\frac{(z-1)(2z^2-z)}{z(z-1)} =$
$\frac{2z^2-z}{z} =$
$\frac{z(2z-1)}{z} = 2z - 1$, choice (D).

56. C

Explanation: Statement (1) is insufficient: there's no way to find the specific values of y and t.

Statement (2) is also insufficient: while you can factor it out to $(y+t)(y-t)$, that doesn't let you solve for the specific values.

Taken together, the statements are sufficient. If $(y+t)(y-t) = 21$ and $y-t = 3$, then $y+t = 7$. With those two linear equations, we can solve for the values of the two variables, and find the value of $y^3 - t^3$. Choice (C) is correct.

57. B

Explanation: Statement (1) is insufficient. If x has only one prime factor, it could be a power of 2 (equal to 2^k), but it could also be a power of any other prime number, such as 3^k or 11^k.

Statement (2) is sufficient. If every factor of x is even, every prime factor of x is even. (Every prime factor must be factor, by definition.) There's only one possible even prime factor, and that's 2, so the only prime factor of x is 2. Thus, x must be equal to 2^k for some integer value of k. (B) is the correct choice.

58. E

Explanation: Statement (1) is insufficient. If $(4-x)^2 < 1$, $4-x$ must be between -1 and 1 (in that range, the squared value will be less than 1), so x must be between 3 and 5. That could be less than or greater than 4.

Statement (2) is also insufficient. If $(x-4)^2 < 1$, $x-4$ must be between -1 and 1. x must be between 5 and 3, which is the same information (1) gave us.

Taken together, the statements are still insufficient. They provide the same information, so combining them doesn't help. Choice (E) is correct.

59. E

Explanation: When comparing the question with the statements, notice that the statements have odd powers–(2) has a power of one on each term, if you want to look at it that way–while the question has even powers. That means that the terms in the statements could be negative, while the terms in the question must be positive.

Statement (1) is insufficient. One example would be $a = 2$, $b = 3$, and $c = 1$, in which case the answer to the question is "yes." However, (1) also works when $a = 2$, $b = 3$, and $c = -4$. In that case, c^2 is greater than $a^2 + b^2$, so the answer is "no."

Statement (2) is also insufficient. The same pair of "yes" and "no" answers applies.

Taken together, the statements are still insufficient. Since we used the same contradictory examples for both statements, we don't gain anything by combining them. They still allow for both of those examples, so we don't know the answer to the question. (E) is the correct choice.

60. A

Explanation: Statement (1) is sufficient. It tells us that p is a multiple of 4, which means that p^2 is a multiple of 16. Taking it one step further, p^2 must also be a multiple of 8, so $p^2 - 1$ is one less than a multiple of 8. That means the remainder is 7 when divided by 8.

Statement (2) is not sufficient. It tells us that p is not a multiple of 8, but nothing more specific than that. (A) is the correct choice.

61. C

Explanation: Statement (1) is insufficient: without any restrictions on the values of x and z, there are an infinite number of possible solutions. For instance, while x could be 2 and z could be -1, x could also be $\frac{1}{2}$ and z could be 1.

Statement (2) is also insufficient. There's a wide range of values for both variables, giving an even wider range of values for the product xz.

Taken together, the statements are sufficient. The only set of values for which x is a positive integer, z is a negative integer, and $x^z = \frac{1}{2}$ is $x = 2$, $z = -1$. $\frac{1}{2} = 2^{-1}$, and since 2 is a prime number, there is no way to generate another set of values for the variables. (C) is the correct choice.

62. B

Explanation: Statement (1) is insufficient: x is less than x^2 for all numbers except for those between 0 and 1. So, x could be negative, or it could be greater than 1.

Statement (2) is sufficient: to simplify, divide both sides of the equation by x^2:

$x^2 < x^3$

$1 < x$

If x is greater than 1, x must be greater than zero. Choice (B) is correct.

63. B

Explanation: Statement (1) is insufficient. You can solve for 8^n as follows:

$8^{n-1} = 8^n 8^{-1} = \frac{8^n}{8}$

$\frac{8^n}{8} > 50$

$8^n > 400$

If 8^n is greater than 400, it might be less than 1,000, but it might be greater than 1,000.

Statement (2) is sufficient. We know that because there's only one variable in the equation, so we know we could solve for that variable. However, it's useful to know how to solve, as well:

$8^n = 8^{n-1} + 448$

$8^n - 8^{n-1} = 448$

$8^n(1 - \frac{1}{8}) = 448$

$8^n(\frac{7}{8}) = 448$

$8^n = 448(\frac{8}{7}) = 512$

That must be less than 1,000. Choice (B) is correct.

64. A

Explanation: Statement (1) is sufficient: substitute the value of x^m from (1) into the question:

$\left(\frac{16(x^n)}{x^n}\right)^4 = (16)^4$

You don't need to evaluate that expression; it's enough to know that you could find the answer. Statement (2) is not sufficient: if you plug $x^n = 16$ into the question, the result is:

$\left(\frac{x^m}{16}\right)^4$

Given that you don't know the value of either of the two variables, it's not enough information. Choice (A) is correct.

65. E

Explanation: Statement (1) is insufficient: if $j^2 = j$, j could be equal to 0 or 1. Statement (2) is also insufficient: j could be equal to -1, 0, or 1. Put them together, and j could still be either 0 or 1. If $j = 0$, the answer is "no," but if $j = 1$, the answer is "yes." Choice (E) is correct.

66. D

Explanation: Statement (1) is sufficient. If n is even, then $n^2 = (even)^2 = even$.

Statement (2) is also sufficient. $n^2 = ((\sqrt{n})^2)^2$, so if $\sqrt{n} = even$, then $n^2 = ((even)^2)^2 = even^2 = even$. Choice (D) is correct.

67. E

Explanation: x^2 is greater than x for all numbers except for those values of x between 0 and 1. Thus, we need to know whether or not x falls in that range.

Statement (1) is insufficient. To simplify, divide both sides by x^2, resulting in $1 > x$. If that's true, x could be between 0 and 1, but it could also be less than 0.

Statement (2) is also insufficient. Again, simplify by dividing by x^2, which gives you $1 > x^2$. Thus, x could be any number between -1 and 1. Again, it could be between 0 and 1, but it could also be between -1 and 0.

Taken together, it's still insufficient. Both statements allow for the possibility that x is between 0 and 1, but both statements also make it possible that x is between -1 and 0. Choice (E) is correct.

68. A

Explanation: Statement (1) is sufficient. $yz^2 = (yz)z$. Since $yz = 6$, (1) tells us that $6z = -12$, so $z = -2$. With that information, we can determine that $y = -3$, so we can find the value of $yz(y - z)$.

Statement (2) is insufficient: there's no way to combine that equation with the given equation to find the values of the two variables. While they are two equations with two variables, the first equation, $yz = 6$ is not a linear equation, so we would get two sets of answers for y and z. Choice (A) is correct.

69. B

Explanation: When you're dealing with terms like x, x^2, and x^3, remember that there are four important types of numbers to test: positive numbers greater than 1, negative numbers less than 1, positive fractions (between 0 and 1) and negative fractions (between 0 and -1).

Statement (1) is insufficient: x is greater than x^3 when x is a negative number less than 1 (for instance, -2 is greater than -8) and when x is a positive fraction ($\frac{1}{2}$ is greater than $\frac{1}{8}$). In the first case, x is not greater than x^2, so the answer is "no." In the second case, x is greater than x^2, so the answer is "yes."

Statement (2) is sufficient: x is only greater than x^4 when x is between 0 and 1: if $x = \frac{1}{2}$, $x^4 = \frac{1}{16}$. When x is between 0 and 1, x is also greater than x^2, so the answer is "yes." Since there isn't a contradictory case, the correct choice is (B).

70. B

Explanation: Statement (1) is insufficient. If $(x-1)^2 > 1$, then $x-1$ must either be greater than 1 or less than -1. In the first case, x must be greater than 2; in the second case, x must be less than 0. If we don't know which case applies, we don't know whether $x > 2$.

Statement (2) is sufficient. If $\sqrt{x-1} > 1$, $x-1$ must be greater than 1. (On the GMAT, there's no taking the square root of a negative number.) If $x-1 > 1$, $x > 2$, which answers the question. (B) is the correct choice.

71. D

Explanation: Statement (1) is sufficient. If $x < x^2$, x could be any number EXCEPT for the range between 0 and 1, in which x^2 is smaller than x. Since we know x isn't in that range, we can answer the question.

Statement (2) is sufficient. When $x < x^3$, x cannot be between 0 and 1: as with (1), in that range, x is greater than x^3. Choice (D) is correct.

72. D

Explanation: $\frac{30-x}{x} = \frac{30}{x} - \frac{x}{x} = \frac{30}{x} - 1$. To determine whether that expression is an integer, we need to know whether x is a factor of 30.

Statement (1) is sufficient. It's equivalent to the following:

$x(x+1) = 30$

Since x is an integer, both x and $x+1$ must be factors of 30.

Statement (2) is also sufficient. Simplify:

$2x^2 - 4x = 30$

$x^2 - 2x = 15$

$x(x-2) = 15$

Again, since x is an integer, both x and $x-2$ must be factors of 15. Factors of 15 are also factors of 30, so it's relevant to the question. Choice (D) is correct.

73. D

Explanation: First, simplify the question:

$\frac{3^{x+2}}{9} > 1$?
$3^{x+2} > 9$?
$3^{x+2} > 3^2$?
$x + 2 > 2$?
$x > 0$?
That's much easier to work with.

Statement (1) is sufficient. If $9^x > 1$, $9^x > 9^0$, or $x > 0$. That answers the question.

Statement (2) answers the question even more directly. Choice (D) is correct.

74. D

Explanation: Statement (1) is sufficient. An even integer raised to a positive integer power will always equal an integer.

Statement (2) is also sufficient. If $\sqrt{m}$ is an even integer, then m is an even integer as well. Thus, if $m = 2(int)$, then $(\sqrt{k})^m = (\sqrt{k})^{2(int)} = ((\sqrt{k})^2)^{int} = (k)^{int}$. Since k is a positive integer, we know that k to an integer power is also an integer. Choice (D) is correct.

75. D

Explanation: Statement (1) is sufficient: the only units digit that doubles when squared is 2: a number with a units digit of 2, such as 12, has a units digit of 4 ($12^2 = 144$) when squared.

Statement (2) is sufficient: the only units digit that quadruples when cubed is also 2. A number with a units digit of 2, such as 2, has a units digit of 8 ($2^3 = 8$) when cubed.

Choice (D) is correct.

76. B

Explanation: The remainder when a number is divided by 10 is equal to the number's units digit. It's useful to realize that integer powers of 9 have only two possible units digits, 1 and 9:
$9^1 = 9$
$9^2 = 81$
$9^3 = 729$
$9^4 = 6561$
If the power is odd, the units digit (the remainder when divided by 10) is 9, and if the power is even, the remainder is 1.

Statement (1) is insufficient. It simplifies the exponent to $7 + b$. Without knowing the value of b, we can't determine whether the exponent is even or odd.

Statement (2) is sufficient. $2a$ is always even when a is an integer, so $2a + 1 + b = even + 1 + odd = even$. Since we know the exponent is even, we know the remainder is 1. Choice (B) is correct.

77. A

Explanation: Work with statement (1) to see if the given equation can prove useful:
$a = \frac{18}{b^2}$
$ab^2 = 18$
$ab(b) = 18$
Since $ab = c$:
$cb = 18$, which answers the question.
Statement (2) is insufficient. There's no way to find the value of c, so you can't answer the question. Choice (A) is correct.

78. E
Explanation: Statement (1) is insufficient: r^2 must be at least zero, since if $r = 0$, $r^2 = 0$, and if r is negative, r^2 is positive. However, since it can be zero, $r^2 - 1$ can be -1, so t can be less that zero.
Statement (2) is also insufficient. Again s^4 must be at least zero, since if $s = 0$, $s^4 = 0$, but $s^4 - 1 = -1$. Most values of s make t positive, but there are a couple (including $s = 0$) that do not.
Taken together, the statements are insufficient. There is no way to combine them, since there is no given relationship between r and s. Choice (E) is correct.

79. E
Explanation: It's useful to rewrite any common binomials:
$S = (x + y)^2$
Statement (1) is insufficient. It allows us to find the value of S, but not xy. There are many combinations of values for x and y that add up to 1, and many of them give different results for xy.
Statement (2) is insufficient, and tells us the same thing.

80. B
Explanation: If $n^k = 1$, either n is 1 (with any power) or -1 (with an even power), or k is zero, in which case n can be any number.
Statement (1) in insufficient: without knowing anything about k, n^k could be anything.
Statement(2) is sufficient. The only time two consecutive numbers raised to the same power are equal is when the power is 0, in which case both n^k and $(n + 1)^k$ are equal to 1. $k = 0$, and (B) is the correct choice.

81. D
Explanation: To determine whether the expression is even, you need to know whether at least one of the two terms is even.
Statement (1) is sufficient. If x is even, both of the terms are odd:
$x^2 - 1 = (even)^2 - 1 = even - 1 = odd$
$x - 3 = even - 3 = odd$
Statement (2) is also sufficient, with the same result. If all the prime factors of (x^2+1) are greater than 3, it is the product of only odd numbers, which means it is also an odd number. If $x^2 + 1$ is odd, x^2 is even, and since x is an integer,

x is also even. That takes us back to where we started with (1). If (1) was sufficient based on that information, (2) will be, as well. Choice (D) is correct.

82. D

Explanation: Statement (1) is sufficient. Since 14 and 15 have no factors in common, we can write $P = 14(15)(int)$. We want to know whether the units digit is 0, which will only be the case if P is a multiple of 10, which is the same as being a multiple of both 2 and 5:

$P = (2)(7)(3)(5)(int)$
$P = (2)(5)(7)(3)(int)$
$P = (10)(7)(3)(int)$

It doesn't matter what the rest of the number is, as long as we know that 10 is a factor. Then the units digit is 0.

Statement (2) is also sufficient. As we've seen, a number has a units digit of 0 when 10 is a factor. (2) tells us that 2 and 5 are both factors, so 10 must be a factor as well. (C) is the correct choice.

83. D

Explanation: Statement (1) is sufficient. $144 = 2^4 3^2$, so $a = 4$ and $b = 2$. There's only one possible prime factorization of any given number, so that's the only possible answer.

Statement (2) is also sufficient. $(2^a)(2^b) = 2^{a+b}$, and $64 = 2^6$. Thus, $a + b = 6$. Choice (D) is correct.

84. B

Explanation: Statement (1) is insufficient: it's a classic GMAT trick. j could be 4 or -4.

Statement (2) is sufficient. Rearrange the equation to set one side equal to zero:

$j^2 - 8j + 16 = 0$
$(j - 4)^2 = 0$
$j = 4$

In this particular quadratic equation, there's only one answer. Choice (B) is correct.

85. D

Explanation: Since we're looking for x, solve the given equation for x:

$\frac{\sqrt{x}}{w} = z$
$\sqrt{x} = wz$
$x = (wz)^2$

Statement (1) is sufficient: given wz, we can find $(wz)^2$, which is equal to x.

Statement (2) is also sufficient. Given the values of w and z, you can find $(wz)^2$, which is equal to x. Choice (D) is correct.

86. E

Explanation: Statement (1) is insufficient: if $(x+1)^2 > 4$, $x+1$ is either greater than $\sqrt{4}$ or less than $-\sqrt{4}$. The resulting solutions for x are:

$x+1 > 2$

$x > 1$

$x+1 < -2$

$x < -3$

Neither one, let alone the combination of both, will answer the question.

Statement (2) is also insufficient. If $(x-1)^2 > 4$, $x-1$ is either greater than $\sqrt{4}$ or less than $-\sqrt{4}$. The resulting solutions are:

$x-1 > 2$

$x > 3$

$x-1 < -2$

$x < -1$

Again, neither one, let alone the combination, will answer the question.

Taken together, we still don't have enough information. We can deduce that x must be greater than 3 or less than -3, but that doesn't tell us whether it is greater than 4. Choice (E) is correct.

87. A

Explanation: To translate the question into algebra:

$x - y < \frac{1}{2}(3^k - 2^k)$?

Statement (1) allows us to drastically reduce the number of terms in that question:

$3^{k-1} - 2^{k-1} < \frac{1}{2}(3^k - 2^k)$?

$3^k 3^{-1} - 2^k 2^{-1} < \frac{1}{2}3^k - \frac{1}{2}2^k$?

$\frac{1}{3}3^k - \frac{1}{2}2^k < \frac{1}{2}3^k - \frac{1}{2}2^k$?

$\frac{1}{3}3^k < \frac{1}{2}3^k$?

$\frac{1}{3} < \frac{1}{2}$?

Finally, we have an answer. We know that $\frac{1}{2}$ is greater than $\frac{1}{3}$, so the answer is "yes."

Statement (2) is insufficient. On its own, it leaves too many variables, as we know nothing about the values of x and y. Choice (A) is correct.

88. B

Explanation: Statement (1) is insufficient. Substitute the value of z into the question:

$\sqrt{2x+z} = int$?

$\sqrt{2x+2x+1} = int$?

$\sqrt{4x+1} = int$?

We don't know. If $x = 4$, $\sqrt{17}$ is not an integer, but if $x = 6$, $\sqrt{25}$ is an integer.

Statement (2) is sufficient:

$\sqrt{2x+(x^2+1)} = int$?

$\sqrt{x^2+2x+1} = int$?

$\sqrt{(x+1)^2} = int$?

$x+1 = int$?

Since we're told that x is an integer, we know that $x+1$ is an integer, as well. Choice (B) is correct.

89. E
Explanation: $x^4 - y^4$ is the difference of squares, and equal to $(x^2 - y^2)(x^2 + x^2)$, or $(x+y)(x-y)(x^2+x^2)$.
Statement (1) is insufficient: it gives us only one of the terms we need to find the difference of squares we're looking for.
Statement (2) is also insufficient: that only provides one of the three terms of the second form in which we wrote it.
Taken together, the statements are still insufficient. There is no way to combine them to find the values of x and y, and no way to use the equations above to solve:
$x^4 - y^4 = (x+y)(x-y)(x^2+x^2)$
$x^4 - y^4 = (7)(x-y)(29)$
Without finding the value of $x-y$, we can't answer the question. (E) is the correct choice.

90. A
Explanation: Statement (1) is sufficient. Square both sides to isolate p:
$\left(2^z + \frac{1}{2^z}\right)^2 = \left(\sqrt{p+2}\right)^2$
$2^{2z} + 2(2^z)(\frac{1}{2^z}) + (\frac{1}{2^z})^2 = p+2$
$(2^2)^z + 2(1) + \frac{1}{2^{2z}} = p+2$
$4^z + \frac{1}{(2^2)^z} = p$
$4^z + \frac{1}{(4)^z} = p$
That's what the question wants us to figure out, so it's enough information.
Statement (2) is insufficient: not only does it not provide a specific value for z, it doesn't say anything about p. Choice (A) is correct.

91. B
Explanation: Statement (1) is insufficient. To solve for b, take the third root of both sides:
$\sqrt[3]{b^3} = \sqrt[3]{int}$
$b = \sqrt[3]{int}$
We don't know whether the third root of this particular integer is an integer itself.
Statement (2) is sufficient. To solve for b, cube each side:
$(\sqrt[3]{b})^3 = (int)^3$
$b = int^3$
The cube of an integer is always an integer, so we know that b is an integer. Choice (B) is correct.

92. D
Explanation: See if you can rework the question:
$k^3 - k = k(k^2-1) = k(k+1)(k-1)$

In other words, $k^3 - k$ is the product of three consecutive integers, the middle of which is k. If one of the three integers is divisible by 4, the product of the three integers is divisible by 4.

Statement (1) is sufficient. If $k + 2$ is divisible by 4, then $k + 1$, k, and $k - 1$ are all NOT divisible by 4. k is even, but not divisible by 4, while the other two terms are odd. The product of the three integers is even, but not a multiple of 4.

Statement (2) is also sufficient. If $k - 2$ is divisible by 4, that has the same implications as the fact that $k + 2$ is divisible by 4. In fact, one requires the other, since $k - 2$ and $k + 2$ are four apart. In this case, again, the three consecutive integers do not include a multiple of 4, and have only one even integer among them, so the product is not a multiple of 4. (D) is the correct choice.

93. D

Explanation: Statement (1) is sufficient. $\sqrt{4y} = 2\sqrt{y}$. If the product of 2 and $\sqrt{y}$ is not an integer, it must be because $\sqrt{y}$ is not an integer. If $\sqrt{y}$ were an integer, $2\sqrt{y}$ would be an integer.

Statement (2) is also sufficient. $\sqrt{5y} = \sqrt{5}\sqrt{y}$. $\sqrt{5}$ is not an integer, so if the product is an integer, $\sqrt{y}$ must not be an integer as well. If $\sqrt{y}$ were an integer, $\sqrt{5}\sqrt{y}$ would be a non-integer, since the only way for $\sqrt{5y}$ to be an integer is if $\sqrt{y}$ has a $\sqrt{5}$ in it: for instance, if $\sqrt{y} = 3\sqrt{5}$, or something similar. Choice (D) is correct.

94. B

Explanation: For $\sqrt{\sqrt{x}}$ to be an integer, x must be the square of a square.

Statement (1) is insufficient: if x is a square, $\sqrt{x}$ is an integer, but all we know about $\sqrt{\sqrt{x}}$ is that it's the square root of an integer.

Statement (2) is sufficient. If $\sqrt{x}$ is the square of an integer, $\sqrt{\sqrt{x}} = \sqrt{square} = int$. Choice (B) is correct.

95. C

Explanation: Statement (1) is insufficient. To confirm, try simplifying by substituting the value of m:

$m^n < n^m$?
$(\sqrt{n})^n < n^{\sqrt{n}}$?
$(n^{\frac{1}{2}})^n < n^{\sqrt{n}}$?
$(n)^{\frac{1}{2}n} < n^{\sqrt{n}}$?
$\frac{1}{2}n < \sqrt{n}$?
$\frac{1}{2}\sqrt{n} < 1$?
$\sqrt{n} < 2$?

We don't know the value of n, so we can't answer the question.

Statement (2) is also insufficient: it tells us nothing about m.

Taken together, the statements are sufficient. If $n > 5$, then $\sqrt{n} > \sqrt{5}$, which is larger than 2. The question is essentially asking whether $\sqrt{n}$ is less than 2, so we can answer "no." Choice (C) is correct.

96. C

Explanation: Statement (1) is insufficient: it gives us a wide range of possibilities for p between 10 and 28, any of which result in a different answer.

Statement (2) is also insufficient: p could be 3, 9, or 27, all of which are powers of 3 and less than 29.

Taken together, the statements are sufficient. Of the possibilities allowed by (2), only one is two digits, 27. $p = 27$, which leaves us with only one possible answer to the question. Choice (C) is correct.

97. B

Explanation: Since we know that s is positive, finding out whether rs is positive is the same as determining whether r is positive.

Statement (1) is insufficient. In fact, we already know that. No matter what the value of r, r^2 is positive. Since we already know that s is positive, we already know that r^2s is positive.

Statement (2) is sufficient. If $rs^2 > 0$ and $s > 0$, r must be positive as well. Choice (B) is correct.

98. D

Explanation: Statement (1) is sufficient. If $y - x$ is positive, that means $x - y$ (which is equal to $-1(y - x)$) is negative. x^2 is always positive, since any number squared is positive, so it must be greater than a negative number.

Statement (2) is also sufficient. y is positive, so $x - y$ is less than x. Since x is greater than 1, x^2 is greater than x, so $x^2 > x > x - y$, or, more directly: $x^2 > x - y$. Choice (D) is correct.

99. A

Explanation: Statement (1) is sufficient. It's equivalent to this:

$x = m^2 + 4m + 4$

When divided by m, x equals:

$\frac{m^2+4m+4}{m} = m + 4 + \frac{4}{m}$

$m + 4$ is an integer, so that has no bearing on the remainder. However, $\frac{4}{m}$ is the key. Since m is greater than 4, 4 is what's left over when x is divided by m; by definition, that's the remainder.

Statement (2) is insufficient: knowing the value of m tells us nothing about x, which we need to find the remainder. Choice (A) is correct.

100. C

Explanation: Statement (1) is insufficient: if x^5 is positive, then x must be positive, but it could be greater than or less than one.

Statement (2) is sufficient: if x^4 is less than x, x cannot be negative, as x^4 will always be positive. Similarly, if x is greater than 1, x^4 will be greater than x, so the only possible numbers that make this statement true are between 0 and 1. (B) is the correct choice.